



SEQUENCE LISTING

<110> Cahoon, Rebecca E.  
Hitz, William D.  
Thorpe, Catherine J.  
Tingey, Scott V.

<120> PHYTIC ACID BIOSYNTHETIC ENZYMES

<130> BB1165 US NA

<140> 09/686,522

<141> 2000-10-11

<150> 60/082,960

<151> 1998-04-24

<150> PCT/US99/08790

<151> 1999-04-22

<160> 24

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<212> DNA

<213> Oryza sativa

<400> 1

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<212> PRT

<213> Oryza sativa

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20 25 30
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```
His Lys Gly Gln Val Asp Leu Val Thr Glu Thr Asp Lys Ala Cys Glu
35 40 45
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Asp Leu Ile Phe Asn His Leu Arg Lys His Tyr Pro Asp His Lys Phe
50 55 60
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Ile Gly Glu Glu Thr Ser Ala Gly Leu Gly Ala Thr Ala Asp Leu Thr
65 70 75 80
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TECH CENTER 1600/2900

Asp Asp Pro Thr Trp Ile Val Asp Pro Leu Asp Gly Thr Thr Asn Phe  
85 90 95

Val His Gly Phe Pro Phe Val Cys Val Ser Ile Gly Leu Thr Val Gly  
100 105 110

Lys Ile  
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<212> DNA  
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tcctcgcatc tgcggtcgac gcggctcaga aagctggcga gattattcga aaaggcttct 180  
accagaccaa aaatgtggaa cacaaaggac aggttgattt ggtcacagaa actgataaag 240  
catgtgaaga actcatattt aatcatctga aacagcttta tcccactcac aagttcattg 300  
gggaagagac cacagctgcc tatggcacta cagaacttac agatgaaccc acatggatat 360  
tgatccctgg atggaactac taacttgtgc atgggttccc ttgtttgtg tccattggc 420  
tcacaattgg aaaaatctac aattggtgtt gtatacaatc aatataatga cttttctgga 480  
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20 25 30

Lys Asn Val Glu His Lys Gly Gln Val Asp Leu Val Thr Glu Thr Asp  
35 40 45

Lys Ala Cys Glu Glu Leu Ile Phe Asn His Leu Lys Gln Leu Tyr Pro  
50 55 60

Thr His Lys Phe Ile Gly Glu Glu Thr Thr Ala Ala Tyr Gly Thr Thr  
65 70 75 80

Glu Leu Thr Asp Glu Pro Thr Trp Ile Val Asp Pro Leu Asp Gly Thr  
85 90 95

Thr Asn Phe Val His Gly Phe Pro Phe Val Cys Val Ser Ile Gly Leu  
100 105 110

Thr Ile Gly Lys Thr Pro Thr Ile Gly Val Val Tyr Asn Pro Ile Ile  
115 120 125

Asn Glu Leu Phe Thr Gly Ile His Gly Lys Gly Ala Phe Leu Asn Gly  
130 135 140

Asn Pro Ile Lys Val Ser Ser Gln Thr Glu Leu Ile Ser Ser Leu Leu  
145 150 155 160

Ala Thr Glu Ala Gly Thr Lys Arg  
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<211> 667  
<212> DNA  
<213> Glycine max

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cagattttgc aataacatct cagcgagtag cagtttcaaa ccctttctaa aaggatgaac 180  
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aagttttacg tagaagttcc aggttaaaaa ggttttagaa ttttaacttc ctccgggggc 360  
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cggaaggcc gtgggcattc gggaaaccgg taccaatcaa ggatcctccc ggaaccctaa 540  
ggcaaggcaa accgcggcac gggcttgggc caaaccccg tgaaccgccg cccaccaacg 600  
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<220>  
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<223> Xaa = any amino acid

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1 5 10 15

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20 25 30

Val Val Phe Asp Pro Ser Gly Ala Asp Phe Ala Ile Thr Ser Gln Arg  
35 40 45

Val Ala Val Ser Asn Pro Phe Xaa Lys Asp Glu Leu Val Glu Thr Arg  
50 55 60

Arg Lys Met Gly Trp Glu Ile Tyr Asn  
65 70

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<211> 1003  
<212> DNA  
<213> Triticum aestivum

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agggccaggt ggatttggtg acggagacgg acaaggcatg cgaggatctc atcttcaacc 180  
acctccggat gctctacccg gaccacaagt tcatcggcga ggagacgtct gcagccctcg 240  
gctccaccga tgacctcacc tacgacccca cctggatagt cgacccccctc gatggcacca 300  
ccaacttcgt tcatggcctt ccttttgtgt gcgtctcgat tggcctcacc attgggaaga 360  
ttcccaccgt tggagttgtg tacaacccca tcatgaatga gcttttcaca gctgttcgtg 420  
gaaaagggtgc ttttctcaat ggctctccaa ttaaaacatc gcctcaaaat gagttggtga 480  
aggctcttat ggtgacagag gtagggacca aaagagacaa gtccactttg gatgatacaa 540  
ccaacagaat taataagtta ctattcaaga ttagatctat acgtatgtgt ggctcttttg 600  
ctctaaacat gtgtggagtt gcttgtggta ggctagattt gtgttatgag atcgggtttt 660  
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<211> 267  
<212> PRT  
<213> Triticum aestivum

<400> 8  
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1 5 10 15

Ala Gly Glu Ile Ile Arg Lys Ser Phe Tyr Leu Ser Lys Lys Val Glu  
20 25 30

His Lys Gly Gln Val Asp Leu Val Thr Glu Thr Asp Lys Ala Cys Glu  
35 40 45

Asp Leu Ile Phe Asn His Leu Arg Met Leu Tyr Pro Asp His Lys Phe  
50 55 60

Ile Gly Glu Glu Thr Ser Ala Ala Leu Gly Ser Thr Asp Asp Leu Thr  
65 70 75 80

Tyr	Asp	Pro	Thr	Trp	Ile	Val	Asp	Pro	Leu	Asp	Gly	Thr	Thr	Asn	Phe	
				85					90					95		
Val	His	Gly	Phe	Pro	Phe	Val	Cys	Val	Ser	Ile	Gly	Leu	Thr	Ile	Gly	
			100					105					110			
Lys	Ile	Pro	Thr	Val	Gly	Val	Val	Tyr	Asn	Pro	Ile	Met	Asn	Glu	Leu	
		115					120					125				
Phe	Thr	Ala	Val	Arg	Gly	Lys	Gly	Ala	Phe	Leu	Asn	Gly	Ser	Pro	Ile	
		130				135					140					
Lys	Thr	Ser	Pro	Gln	Asn	Glu	Leu	Val	Lys	Ala	Leu	Met	Val	Thr	Glu	
145					150					155					160	
Val	Gly	Thr	Lys	Arg	Asp	Lys	Ser	Thr	Leu	Asp	Asp	Thr	Thr	Asn	Arg	
				165					170					175		
Ile	Asn	Lys	Leu	Leu	Phe	Lys	Ile	Arg	Ser	Ile	Arg	Met	Cys	Gly	Ser	
			180					185					190			
Leu	Ala	Leu	Asn	Met	Cys	Gly	Val	Ala	Cys	Gly	Arg	Leu	Asp	Leu	Cys	
		195					200					205				
Tyr	Glu	Ile	Gly	Phe	Gly	Gly	Pro	Trp	Asp	Val	Ala	Ala	Gly	Ala	Leu	
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Ile	Leu	Lys	Glu	Ala	Gly	Gly	Phe	Val	Phe	Asp	Pro	Ser	Gly	Asp	Glu	
225					230					235					240	
Phe	Asp	Leu	Met	Ala	Gln	Arg	Met	Ala	Gly	Ser	Asn	Gly	His	Leu	Lys	
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 <212> DNA  
 <213> Hordeum vulgare

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 gtgcattgat ccttttagatg gaacaacaaa ctttgcacat gggtacccca gcttttctgt 180  
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 tactgatgtt agcaggggag tacgaaggct aggctctgct gctgccgata tgtcccatgt 480  
 tgggtctaggc attacagaag cctactggga atatcggtt aagccgtggg acatggctgc 540  
 tggcgttctg atagttgaag aagctggtgg agtagtgaca cgcatggatg gtggggagtt 600  
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 gagctcgaat gagcttctca ctggattcct tttgctttga tcgaatgtat caggaagaaa 960  
 tgtttgcaaa aggtgttgta tgcattggtc cagcctgttg tacttggaat aatataactg 1020  
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aaaaaaaaaa

<210> 10  
 <211> 249  
 <212> PRT  
 <213> Hordeum vulgare

<400> 10  
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 Asn Phe Arg Asp His Leu Ile Leu Gly Glu Glu Gly Gly Leu Ile Gly  
                   20                  25                  30  
 Asp Ser Leu Ser Glu Tyr Leu Trp Cys Ile Asp Pro Leu Asp Gly Thr  
                   35                  40                  45  
 Thr Asn Phe Ala His Gly Tyr Pro Ser Phe Ser Val Ser Ile Gly Val  
                   50                  55                  60  
 Leu Tyr Arg Gly Lys Pro Ala Ala Ala Thr Val Val Glu Phe Cys Gly  
   65                  70                  75                  80  
 Gly Pro Met Cys Trp Ser Thr Arg Thr Ile Ser Ala Ser Ser Gly Lys  
                   85                  90                  95  
 Gly Ala Tyr Cys Asn Gly Gln Lys Ile His Val Ser Pro Thr Glu Lys  
                   100                  105                  110  
 Val Glu Gln Ser Leu Leu Val Thr Gly Phe Gly Tyr Glu His Asp Asp  
                   115                  120                  125  
 Ala Trp Leu Thr Asn Ile Asn Leu Phe Lys Glu Phe Thr Asp Val Ser  
                   130                  135                  140  
 Arg Gly Val Arg Arg Leu Gly Ser Ala Ala Ala Asp Met Ser His Val  
   145                  150                  155                  160  
 Gly Leu Gly Ile Thr Glu Ala Tyr Trp Glu Tyr Arg Leu Lys Pro Trp  
                   165                  170                  175  
 Asp Met Ala Ala Gly Val Leu Ile Val Glu Glu Ala Gly Gly Val Val  
                   180                  185                  190  
 Thr Arg Met Asp Gly Gly Glu Phe Thr Val Phe Asp Arg Ser Val Leu  
                   195                  200                  205  
 Val Ser Asn Gly Val Val His Asp Gln Leu Leu Glu Arg Ile Arg Pro  
                   210                  215                  220  
 Ala Thr Glu Asp Leu Lys Lys Lys Gly Ile Asp Phe Ser Leu Trp Phe  
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 Lys Pro Asp Lys Tyr Pro Thr Asp Phe  
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<210> 11  
 <211> 989  
 <212> DNA  
 <213> Zea mays

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aaaaaaaaatg atggctgctt tattatgggt gccaatggct ggtggtggtg cccttggtgc 180
agctcaaaaag tcagtcgggt acttgtcagg cttgaaccac aacgagaagt cgatcccttt 240
cttcttaagg tcttcagtag gagggccgat ccggtccaaa agctgtccac acagacaaca 300
ctaagaacaa aacctgtcca tgaacgccac aaacaatatg ccaaattggt cacaacaaac 360
aaacctgtcc atgaacaagt ccgttggaaa caagaacaga gcgatcgaag accgtaaact 420
ctccaccgtc catgcgagtt accacccccc cagcttcctc tactatcagg acgccagcat 480
gcacatccca tggcttaagt cgggtattccc agtaagcttc tgtaatacca agtccaatgt 540
gggacatgtc agcagcagca gacccgagcc ttcgcactcc cctgctaatt tcagtaaatt 600
ccttgaacag attcatattg gtcgtccagg catcatcgtg ttcatatcca aaacctgtga 660
cgagaagtga ttgttccacc ttgtctgtct gactgacatg aatcctttgt ccaatataat 720
aagctcctcc gccagcaaat ggaaaaattg ttcgggtggt ccaacacata aggccgccac 780
aaaatttctc cccacttgaa accacacggg ttttcccagg aaagaacaac taatggcaca 840
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ttttaattct ttggggaaaa tctcaaaag 989

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<210> 12
<211> 136
<212> PRT
<213> Zea mays

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Tyr Tyr Ile Gly Gln Arg Ile His Val Ser Gln Thr Asp Lys Val Glu
      20              25              30

Gln Ser Leu Leu Val Thr Gly Phe Gly Tyr Glu His Asp Asp Ala Trp
      35              40              45

Thr Thr Asn Met Asn Leu Phe Lys Glu Phe Thr Asp Ile Ser Arg Gly
      50              55              60

Val Arg Arg Leu Gly Ser Ala Ala Ala Asp Met Ser His Ile Gly Leu
      65              70              75              80

Gly Ile Thr Glu Ala Tyr Trp Glu Tyr Arg Leu Lys Pro Trp Asp Val
      85              90              95

His Ala Gly Val Leu Ile Val Glu Glu Ala Gly Gly Val Val Thr Arg
      100              105              110

Met Asp Gly Gly Glu Phe Thr Val Phe Asp Arg Ser Val Leu Val Ser
      115              120              125

Asn Gly Leu Val His Gly Gln Val
      130              135

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<210> 13
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<212> DNA
<213> Zea mays

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<220>

<221> unsure

<222> (442)

<223> n = a, c, g or t

<220>

<221> unsure

<222> (485)

<223> n = a, c, g or t

<400> 13

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cctcgcttcc gcaaacccta acccccgtc tcgctcctc cgcctccgcg ccgcctcgcc 180
cgtgtcgtcc gcggtcttga gcgcgagtgg gcgccagccg atgagtacgg ttagggcctc 240
gttcgccgct ggggcggccg gccggagagc tgcggcagtg ggggagttgg cgacggagcg 300
gctggtggag gtggcgcaac gggcggcgga cgctgctggg gaggtgctca ngaagtactt 360
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<210> 14

<211> 338

<212> PRT

<213> Zea mays

<400> 14

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Gly Leu Ala Ser Ala Asn Pro Asn Pro Arg Ser Arg Leu Leu Arg Leu
          20              25              30

Arg Ala Ala Ser Pro Val Ser Ser Ala Val Leu Ser Ala Ser Gly Arg
          35              40              45

Gln Pro Met Ser Thr Val Arg Ala Ser Phe Ala Ala Gly Ala Ala Gly
          50              55              60

Arg Arg Ala Ala Ala Val Gly Glu Leu Ala Thr Glu Arg Leu Val Glu
          65              70              75              80

Val Ala Gln Arg Ala Ala Asp Ala Ala Gly Glu Val Leu Arg Lys Tyr
          85              90              95

Phe Arg Gln Arg Val Glu Ile Ile Asp Lys Glu Asp His Ser Pro Val
          100              105              110

Thr Ile Ala Asp Arg Glu Ala Glu Glu Ala Met Val Ser Val Ile Leu
          115              120              125

Lys Ser Phe Pro Thr His Ala Ile Phe Gly Glu Glu Asn Gly Trp Arg
          130              135              140

Cys Ala Glu Asn Ser Ala Asp Phe Val Trp Val Leu Asp Pro Ile Asp
          145              150              155              160
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Gly Thr Lys Ser Phe Ile Thr Gly Lys Pro Leu Phe Gly Thr Leu Ile  
 165 170 175  
 Ala Leu Leu His Asn Gly Lys Pro Val Ile Gly Val Ile Asp Gln Pro  
 180 185 190  
 Ile Leu Arg Glu Arg Trp Ile Gly Val Asp Gly Lys Gln Thr Thr Leu  
 195 200 205  
 Asn Gly Gln Glu Ile Ser Val Arg Ser Cys Asn Leu Leu Ala Gln Ala  
 210 215 220  
 Tyr Leu Tyr Thr Thr Ser Pro His Leu Phe Glu Ala Asp Ala Glu Asp  
 225 230 235 240  
 Ala Phe Ile Arg Val Arg Asn Lys Val Lys Val Pro Leu Tyr Gly Cys  
 245 250 255  
 Asp Cys Tyr Ala Tyr Ala Leu Leu Ala Ser Gly Phe Val Asp Ile Val  
 260 265 270  
 Val Glu Ser Gly Leu Lys Pro Tyr Asp Phe Leu Ser Leu Val Pro Val  
 275 280 285  
 Ile Glu Gly Ala Gly Gly Ser Ile Thr Asp Trp Arg Gly Asp Lys Leu  
 290 295 300  
 His Trp Pro Val Thr Ala Glu Ser Arg Pro Thr Ser Phe Asn Val Val  
 305 310 315 320  
 Ala Ala Gly Asp Ala Arg Val His Lys Glu Ala Leu Asp Ala Leu Arg  
 325 330 335

Trp Arg

<210> 15  
 <211> 593  
 <212> DNA  
 <213> Oryza sativa

<400> 15  
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 ctactgggaa taccgactta agccttgagg tatggctgct ggtgttctga tagttgaaga 240  
 agctggtggg atggtgtcac gcatggatgg tggggagttt accgtctttg atcgttctgt 300  
 ccttgtttcc aatggtggtg tacatgatca gcttttggtt cggattggcc ctgccacaga 360  
 agatcttaag aagaaaggaa ttgattttct cttgtgggtt aaacccgaca aataccctac 420  
 cgacttttaa gttgaactcc tcacccagag ctattttata ctactagaag aaaagagaaa 480  
 aacagaggat cttatgttaa aatgccatgt acttgactga atatttggtt attgaagtcc 540  
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<210> 16  
 <211> 142  
 <212> PRT  
 <213> Oryza sativa

<400> 16  
 His Glu Leu Thr Lys Val Glu Gln Ser Leu Leu Val Thr Gly Phe Gly

1	5	10	15
Tyr Glu His Asp Asp Ala Trp Val Thr Asn Ile Asn Leu Phe Lys Glu	20	25	30
Tyr Thr Asp Ile Ser Arg Gly Val Arg Arg Leu Gly Ser Ala Ala Ala	35	40	45
Asp Met Ser His Val Ala Leu Gly Ile Thr Glu Ala Tyr Trp Glu Tyr	50	55	60
Arg Leu Lys Pro Trp Asp Met Ala Ala Gly Val Leu Ile Val Glu Glu	65	70	75
Ala Gly Gly Met Val Ser Arg Met Asp Gly Gly Glu Phe Thr Val Phe	85	90	95
Asp Arg Ser Val Leu Val Ser Asn Gly Val Val His Asp Gln Leu Leu	100	105	110
Asp Arg Ile Gly Pro Ala Thr Glu Asp Leu Lys Lys Lys Gly Ile Asp	115	120	125
Phe Ser Leu Trp Phe Lys Pro Asp Lys Tyr Pro Thr Asp Phe	130	135	140

<210> 17  
 <211> 1103  
 <212> DNA  
 <213> Glycine max

<400> 17  
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 tcggttaacaa agtcgccgat gctgccggag aagttatccg caaatacttc agaaaaaact 180  
 tcgacgttat tcacaaacat gatctcagtc cagtaaccat tgcagatcaa tctgctgagg 240  
 aggctatggt ttcaatcata ctagacaatt tccctttctca tgccattttac ggagaggaaa 300  
 atgggtggag gtgtgaagaa aagaatgctg attatgtttg ggtattagat cccatagatg 360  
 ggactaagag ctttattact gggaaacctg tatttggtac tctcgttgct cttctacaaa 420  
 atggcacacc aatccttggc ataattgatc aacctgtgtt aagagaaagg tggatcggga 480  
 tagcaggaaa gagaacctca ctgaacggac aagaaatata tacacgact tgtgcggacc 540  
 tttctcaagc atacctgtac accacaagcc cacatctgtt caatggagat gcagaagaag 600  
 cattcattcg tgtagaagc aaggtaaaat tccaattgta tggctgcgac tgctatgcat 660  
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 attttcttgc attgattcct gttattgaag gcgctggagg tgtcataact gattggaaag 780  
 gagataaact gttttgggaa gcttctccac tttcaatcgc cacaagtttt aatgttggtg 840  
 ctgctggtga caaacagatt catcaacaag ctctagattc attgcagtgg aagtgatagc 900  
 ttgaattaat cttcagtgca aataatcttc tctgcaaagt gtcttgattc agatgttcct 960  
 aaggacatgt attaccgtac cattttctgg catttaagtt gaaaaccatg tactcagaat 1020  
 cttgaataag ttcctgcaga aattaacctc tttgtctatt ggttggtaaa aaaagggggg 1080  
 gccgtacaaa tctccccgcc ccg 1103

<210> 18  
 <211> 295  
 <212> PRT  
 <213> Glycine max

<400> 18  
 Met Phe Ser Gln Cys His Phe Leu Ser His Ser Pro Ile Pro Asn Thr  
 1 5 10 15



<400> 19

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agcctcgccc tctgaggcgg ggggctgggc ggtggctgcg gcgggtaagg aggggggtgga 180
catggagcgg ctggtggcgg tggcgagag cgcggcggat gcggcggggg aggtgctcag 240
gaagtacttc aggcagcgct tcgagatcat cgacaaagag gaccacagtc ccgtcacgat 300
cgctgataga gaagcagaag aagcaatgac ctacgtcata ctgaagagct ttcctactca 360
tgctgttttc ggtgaggaga acggttggag gtgtgcagag aagtctgctg actatgtttg 420
ggtcttggac cccatagatg gaacaaagag cttcataact gggaagcctc tttttggtac 480
gcttattgcg cttcttcaca atggaaagcc gggttatgggc attattgatc agccaatctt 540
gagagagaga tgggttgggg tggacgggaa gaaaactacc ttaaattggac aagaaatatc 600
tgtccgtcct tgcaatgtac tggagcaagc ttacttatat actacgagtc cacatctctt 660
tgaaggagat gctgaagatg cattcattcg tgtacgagac aagggtgaaag tccattgtga 720
tggctgtgat tggtatgctt atgctctcct ggcttctggt tttgtggatc ttgttgttga 780
atctggattg aagccatacg attttctctc gctgggtaccg gtgattgaag gagctggggg 840
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aacaagtttc aacgtggtgg cagccggaga ttcccatgtc catgggcagg ccctggcagc 960
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caagttgttc acggtgcacc ctttactcaa taatgatcag tggtttcttg ttgtgtgtta 1140
aaaaaaaaaa aaaaaaaaaa aaaaaaaaaa aaaaaaaaaa aaaaaaaaaa aaaaaaaaaa 1200
aaaaaaaaaa aaaaaacaaa aaaaaaaata aaaaaaaaaa aaaacccccg gggggggggc 1260
ggggaccaaa tttcccccata tttttttttt ttttaccccc ccccgagggg gtttttttta 1320
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ccccctttcc ccaagggggg taataaaaaa aaggggccg 1418
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<210> 20

<211> 324

<212> PRT

<213> *Triticum aestivum*

<400> 20

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His Glu Thr Lys Pro Ser Leu Pro Tyr His Leu Arg Ser Pro Ser Leu
  1              5              10              15
```

```
Leu Ala Thr Phe Ser Ser Ser Ala Ala Gly Arg Ala Cys Gly Ile Ala
          20              25              30
```

```
Gly Arg Trp Met Gly Ser Val Arg Ala Ser Pro Ser Glu Ala Gly Gly
          35              40              45
```

```
Trp Ala Val Ala Ala Ala Gly Lys Glu Gly Val Asp Met Glu Arg Leu
          50              55              60
```

```
Val Ala Val Ala Gln Ser Ala Ala Asp Ala Ala Gly Glu Val Leu Arg
          65              70              75              80
```

```
Lys Tyr Phe Arg Gln Arg Phe Glu Ile Ile Asp Lys Glu Asp His Ser
          85              90              95
```

```
Pro Val Thr Ile Ala Asp Arg Glu Ala Glu Glu Ala Met Thr Ser Val
          100             105             110
```

```
Ile Leu Lys Ser Phe Pro Thr His Ala Val Phe Gly Glu Glu Asn Gly
          115             120             125
```

```
Trp Arg Cys Ala Glu Lys Ser Ala Asp Tyr Val Trp Val Leu Asp Pro
          130             135             140
```

```
Ile Asp Gly Thr Lys Ser Phe Ile Thr Gly Lys Pro Leu Phe Gly Thr
```

145						150						155				160
Leu	Ile	Ala	Leu	Leu	His	Asn	Gly	Lys	Pro	Val	Met	Gly	Ile	Ile	Asp	
				165					170						175	
Gln	Pro	Ile	Leu	Arg	Glu	Arg	Trp	Val	Gly	Val	Asp	Gly	Lys	Lys	Thr	
			180					185					190			
Thr	Leu	Asn	Gly	Gln	Glu	Ile	Ser	Val	Arg	Pro	Cys	Asn	Val	Leu	Glu	
		195					200					205				
Gln	Ala	Tyr	Leu	Tyr	Thr	Thr	Ser	Pro	His	Leu	Phe	Glu	Gly	Asp	Ala	
	210					215					220					
Glu	Asp	Ala	Phe	Ile	Arg	Val	Arg	Asp	Lys	Val	Lys	Val	Pro	Leu	Tyr	
225					230					235					240	
Gly	Cys	Asp	Cys	Tyr	Ala	Tyr	Ala	Leu	Leu	Ala	Ser	Gly	Phe	Val	Asp	
				245					250					255		
Leu	Val	Val	Glu	Ser	Gly	Leu	Lys	Pro	Tyr	Asp	Phe	Leu	Ser	Leu	Val	
			260					265					270			
Pro	Val	Ile	Glu	Gly	Ala	Gly	Gly	Ser	Ile	Thr	Asp	Trp	Glu	Gly	Asn	
		275					280					285				
Lys	Leu	His	Trp	Pro	Val	Ser	Ser	Glu	Ser	Arg	Pro	Thr	Ser	Phe	Asn	
	290					295					300					
Val	Val	Ala	Ala	Gly	Asp	Ser	His	Val	His	Gly	Gln	Ala	Leu	Ala	Ala	
305					310					315					320	

Leu Arg Trp Arg

<210> 21  
 <211> 273  
 <212> PRT  
 <213> Lycopersicon esculentum

<400> 21  
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 Ala Ala Lys Arg Ala Gly Glu Ile Ile Arg Lys Gly Phe His Glu Thr  
 20 25 30  
 Lys His Val Val His Lys Gly Gln Val Asp Leu Val Thr Glu Thr Asp  
 35 40 45  
 Lys Ala Cys Glu Asp Leu Ile Phe Asn His Leu Lys Gln His Phe Pro  
 50 55 60  
 Ser His Lys Phe Ile Gly Glu Glu Thr Ser Ala Ala Thr Gly Asp Phe  
 65 70 75 80  
 Asp Leu Thr Asp Glu Pro Thr Trp Ile Val Asp Pro Val Asp Gly Thr  
 85 90 95  
 Thr Asn Phe Val His Gly Phe Pro Ser Val Cys Val Ser Ile Gly Leu

100					105					110					
Thr	Ile	Gly	Lys	Ile	Pro	Thr	Val	Gly	Val	Val	Tyr	Asp	Pro	Ile	Ile
		115					120					125			
Asp	Glu	Leu	Phe	Thr	Gly	Ile	Asn	Gly	Lys	Gly	Ala	Tyr	Leu	Asn	Gly
	130					135					140				
Lys	Pro	Ile	Lys	Val	Ser	Ser	Gln	Ser	Glu	Leu	Val	Lys	Ser	Leu	Leu
145					150					155					160
Gly	Thr	Glu	Val	Gly	Thr	Thr	Arg	Asp	Asn	Leu	Thr	Val	Glu	Thr	Thr
				165					170					175	
Thr	Arg	Arg	Ile	Asn	Asn	Leu	Leu	Phe	Lys	Val	Arg	Ser	Leu	Arg	Met
			180					185					190		
Cys	Gly	Ser	Cys	Ala	Leu	Asp	Leu	Cys	Trp	Val	Ala	Cys	Gly	Arg	Leu
		195					200					205			
Glu	Leu	Phe	Tyr	Leu	Ile	Gly	Tyr	Gly	Gly	Pro	Trp	Asp	Val	Ala	Gly
	210					215					220				
Gly	Ala	Val	Ile	Val	Lys	Glu	Ala	Gly	Gly	Val	Leu	Phe	Asp	Pro	Ser
225					230					235					240
Gly	Ser	Glu	Phe	Asp	Ile	Thr	Ser	Gln	Arg	Val	Ala	Ala	Thr	Asn	Pro
				245					250					255	
His	Leu	Lys	Glu	Ala	Phe	Val	Glu	Ala	Leu	Gln	Leu	Ser	Glu	Tyr	Val
			260					265					270		

Ser

<210> 22  
 <211> 268  
 <212> PRT  
 <213> Lycopersicon esculentum

<400> 22  
 Met Ala Gln Asn Gly Ser Val Glu Gln Phe Leu Asp Val Ala Val Glu  
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 Ala Ala Lys Lys Ala Gly Glu Ile Ile Arg Glu Gly Phe Tyr Lys Thr  
 20 25 30  
 Lys His Val Glu His Lys Gly Met Val Asp Leu Val Thr Glu Thr Asp  
 35 40 45  
 Lys Ala Cys Glu Asp Phe Ile Phe Asn His Leu Lys Gln Arg Phe Pro  
 50 55 60  
 Ser His Lys Phe Ile Gly Glu Glu Thr Thr Ala Ala Cys Gly Asn Phe  
 65 70 75 80  
 Glu Leu Thr Asp Glu Pro Thr Trp Ile Val Asp Pro Leu Asp Gly Thr  
 85 90 95  
 Thr Asn Phe Val His Gly Phe Pro Phe Val Cys Val Ser Ile Gly Leu

	100		105		110										
Thr	Ile	Glu	Lys	Lys	Pro	Thr	Val	Gly	Val	Val	Tyr	Asn	Pro	Ile	Ile
	115						120					125			
Asp	Glu	Leu	Phe	Thr	Gly	Ile	Asp	Gly	Lys	Gly	Ala	Phe	Leu	Asn	Gly
	130					135					140				
Lys	Pro	Ile	Lys	Val	Ser	Ser	Gln	Ser	Glu	Leu	Val	Lys	Ala	Leu	Leu
	145				150					155					160
Ala	Thr	Glu	Ala	Gly	Thr	Asn	Arg	Asp	Lys	Leu	Val	Val	Asp	Ala	Thr
				165					170					175	
Thr	Gly	Arg	Ile	Asn	Ser	Leu	Leu	Phe	Lys	Val	Arg	Ser	Leu	Arg	Met
			180					185					190		
Cys	Gly	Ser	Cys	Ala	Leu	Asn	Leu	Cys	Gly	Val	Ala	Cys	Gly	Arg	Leu
		195					200					205			
Asp	Leu	Phe	Tyr	Glu	Leu	Glu	Phe	Gly	Gly	Pro	Trp	Asp	Val	Ala	Gly
	210					215					220				
Gly	Ala	Val	Ile	Val	Lys	Glu	Ala	Gly	Gly	Phe	Val	Phe	Asp	Pro	Ser
	225				230					235					240
Gly	Ser	Glu	Phe	Asp	Leu	Thr	Ala	Arg	Arg	Val	Ala	Ala	Thr	Asn	Ala
				245					250					255	
His	Leu	Lys	Asp	Ala	Phe	Ile	Lys	Ala	Leu	Asn	Glu				
			260					265							

<210> 23  
 <211> 287  
 <212> PRT  
 <213> Synechocystis sp.

<400> 23  
 Met Thr Ser Ala Gln Lys Pro Val Phe Ser Pro Ser Asp Leu Gln Thr  
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 Trp Leu Glu Ile Ala Thr Glu Ala Val Leu Ala Ala Gly Ala Glu Ile  
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 Phe Ser Leu Trp Gly Lys Val Gln Gln Ile Gln Glu Lys Gly Arg Ala  
 35 40 45  
 Gly Asp Leu Val Thr Glu Ala Asp Arg Gln Ala Glu Ala Ile Ile Leu  
 50 55 60  
 Glu Ile Ile Lys Arg Arg Cys Pro Asp His Ala Ile Leu Ala Glu Glu  
 65 70 75 80  
 Ser Gly Gln Leu Gly Gln Val Asp Asn Pro Phe Cys Trp Ala Ile Asp  
 85 90 95  
 Pro Leu Asp Gly Thr Thr Asn Phe Ala His Ser Tyr Pro Val Ser Cys  
 100 105 110  
 Val Ser Ile Gly Leu Leu Ile Gln Asp Ile Pro Thr Val Gly Val Val

	115	120	125													
Tyr	Asn	Pro	Phe	Arg	Gln	Glu	Leu	Phe	Arg	Ala	Ala	Thr	Ser	Leu	Gly	
	130					135					140					
Ala	Thr	Leu	Asn	Arg	Arg	Pro	Ile	Gln	Val	Ser	Thr	Thr	Ala	Ser	Leu	
145					150					155					160	
Asp	Lys	Ser	Leu	Leu	Val	Thr	Gly	Phe	Ala	Tyr	Asp	Arg	Val	Lys	Thr	
				165					170					175		
Leu	Asp	Asn	Asn	Tyr	Pro	Glu	Phe	Cys	Tyr	Leu	Thr	His	Leu	Thr	Gln	
			180					185					190			
Gly	Val	Arg	Arg	Ser	Gly	Ser	Ala	Ala	Ile	Asp	Leu	Ile	Asp	Val	Ala	
		195					200					205				
Cys	Gly	Arg	Leu	Asp	Gly	Tyr	Trp	Glu	Arg	Gly	Ile	Asn	Pro	Trp	Asp	
	210					215					220					
Met	Ala	Ala	Gly	Ile	Val	Ile	Val	Arg	Glu	Ala	Gly	Gly	Ile	Val	Ser	
225					230					235					240	
Ala	Tyr	Asp	Cys	Ser	Pro	Leu	Asp	Leu	Ser	Thr	Gly	Arg	Ile	Leu	Ala	
				245					250					255		
Thr	Asn	Gly	Lys	Ile	His	Gln	Glu	Leu	Ser	Gln	Ala	Leu	Ala	Ala	Thr	
			260					265					270			
Pro	Gln	Trp	Phe	Gln	Gln	Tyr	Ala	Ala	Ala	Arg	Ala	Gln	Lys	Ile		
		275					280					285				
<210>	24															
<211>	267															
<212>	PRT															
<213>	Synechocystis sp.															
<400>	24															
Met	Leu	Pro	Glu	Val	Glu	Gln	Arg	Leu	Phe	Ile	Ala	Gln	Gln	Leu	Ala	
1				5					10					15		
Ala	Val	Ser	Gly	Glu	Ile	Leu	Ile	Gln	Tyr	Phe	Arg	Arg	Ser	His	Leu	
			20					25					30			
Gln	Gly	Gly	Thr	Lys	Ile	Asp	Gln	Val	Ser	Ala	Ile	Val	Thr	Gln	Ala	
		35					40					45				
Asp	Glu	Glu	Ala	Glu	Gln	Ala	Met	Val	Asp	Leu	Ile	Gln	Ala	Gln	Phe	
	50					55					60					
Pro	Gln	Asp	Gly	Val	Ile	Arg	Glu	Glu	Gly	Lys	Asn	Ile	Ala	Gly	Lys	
65					70					75				80		
Ser	Gly	Tyr	Thr	Trp	Val	Leu	Asp	Pro	Ile	Asp	Gly	Thr	Ser	Ser	Phe	
				85					90					95		
Val	Arg	Gly	Leu	Pro	Ile	Phe	Ala	Thr	Leu	Ile	Gly	Leu	Val	Asp	Ala	
			100					105					110			
Asp	Met	Arg	Pro	Val	Leu	Gly	Ile	Ala	His	Gln	Pro	Ile	Ser	Gly	Asp	



115 120 125  
 Arg Trp Gln Gly Val Gln Gly Glu Gln Ser Asn Val Asn Gly Ile Pro  
 130 135 140  
 Leu Val Asn Pro Tyr Lys Ala Ser Glu Ile Asn Leu Thr Ala Ala Cys  
 145 150 155 160  
 Ile Val Ser Thr Thr Pro Leu Met Phe Thr Thr Pro Val Gln Gln Gln  
 165 170 175  
 Lys Met Ala Asp Ile Tyr Arg Gln Cys Gln Arg Thr Ala Phe Gly Gly  
 180 185 190  
 Asp Cys Phe Asn Tyr Leu Ser Ala Ala Ser Gly Trp Thr Ala Met Pro  
 195 200 205  
 Leu Val Ile Val Glu Ala Asp Leu Asn Phe Tyr Asp Phe Cys Ala Leu  
 210 215 220  
 Ile Pro Ile Leu Thr Gly Ala Asn Tyr Cys Phe Thr Asp Trp Gln Gly  
 225 230 235 240  
 Lys Glu Leu Thr Pro Glu Ser Thr Glu Val Val Ala Ser Pro Asn Pro  
 245 250 255  
 Lys Leu His Ser Glu Ile Leu Ala Phe Leu Gln  
 260 265

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